FLUID DYNAMICS

III Semester: AE

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AAEC03	Core	3	1	0	4	30	70	100
Contact Classes: 45	Tutorial Classes: 15	Practical Classes: Nil				Total Classes:60		

Prerequisites: Linear Algebra and Calculus

I. COURSE OVERVIEW:

Fluid mechanics is the study of fluids either in motion (fluid dynamics) or at rest (fluid statics). This course introduces to a broad range of fundamental concepts, methods of fluid mechanics, mathematical description of fluid flows and the solution of some important flow problems. The course emphasizes importance of dimensionless numbers in various engineering fluid flow problems. It discusses the concept of boundary layer theory and bluff body aerodynamics. Compare and contrast various fluid machinery based on flow properties and its applications.

II. COURSE OBJECTIVES:

The students will try to learn:

- **I** The fundamental knowledge of fluids, their properties and behavior undervarious conditions of closed conduit and external flow systems.
- **II** Various mathematical models in fluid dynamics, how they are derived andhow they can be used to solve practical problems.
- **III** The importance of formation of boundary layer when fluid flows over the solid bodies and effect in reduction of displacement, momentum, energy andpressure gradient.
- **IV** Working principle of various turbo machineries, their application and analyze their characteristics using governing equations.

III. COURSE OUTCOMES:

After successful completion of the course, students should be able to:

CO 1	**Identify** the suitable pressure measuring devices for determiningthe flow measurements in fluid systems	Apply
CO 2	**Utilize** the concept of Similitude and Non Dimensional numbers for validating physical parameters of a designed prototype	Apply
CO 3	**Apply** the law of conservation of mass and momentum for obtaining numerical solutions of internal fluid flow systems	Apply
CO 4	**Utilize** the principle of Bernoulli equation for measurement of discharge in internal and external fluid flow systems	Apply
CO 5	**Apply** boundary layer theory for internal and external flow systems in determining drag forces and frictional losses.	Apply
CO 6	**Classify** the types of hydraulic machines based on working principle and performance characteristics for the selection in realworld applications.	Understand

IV. SYLLABUS:

MODULE – I: FLUID PROPERTIES AND FLUID STATICS(10)

Density, specific weight, specific gravity, surface tension and capillarity, Newton's law of viscosity, incompressible and compressible fluid, numerical problems; Hydrostatic forces on submerged bodies - Pressure at a point, Pascal's law, pressure variation with temperature and height, center of pressure plane, vertical and inclined surfaces; Manometers - simple and differential Manometers, inverted manometers, micro manometers, pressure gauges and numerical problems. Buoyancy - Archimedes principle, metacenter, Meta centric height calculations; Stability.

MODULE – II: DIMENSIONAL ANALYSIS(10)

Fundamental and secondary quantities, Dimensional homogeneity, Methods of dimensional Analysis- Rayleigh's method, Buckingham's π- theorem, method of selecting repeating variables, similarity parameters - Reynolds number, Froude number, Euler's number, Weber's number, Mach number concepts of geometric, kinematic and dynamic similarity.

MODULE – III: KINEMATICS AND DYNAMICS OF FLUIDS(10)
Methods of describing fluid motion, types of fluid flows, differential form of continuity equation- Cartesian, cylindrical and polar coordinate system, Numerical problems

Euler's equation of Motion; Bernoulli's equation, Application of Bernoulli's equation in flow measurements: velocity and mass flow rate, pitot-static tube, venturi meter, orifice meter and V-Notch

MODULE - IV BOUNDARY LAYER THEORY (09)
Introduction and classification of boundary layer, boundary layer properties- Displacement, momentum and energy thickness, idea of boundary layer separation, streamlined and bluff bodies, drag force on flat due to boundary layer.

MODULE - V TURBO MACHINERY(09)
Introduction and classification of fluid machines: Turbo machinery analysis; The angular momentum principle;
Euler turbo machine equation; Application to fluid systems, working principle overview of turbines, fans, pumps and compressors.

V. TEXT BOOKS:

1. D.J Tritton, "Physical Fluid Dynamics", Oxford university press, 2nd Edition 2016.
2. R. K Bansal, "Fluid mechanics and hydraulic machines", Laxmi publications ltd, 9th Edition, 2011.
3. Robert W Fox, Alan T McDonald, "Introduction to fluid Mechanics", John Wiley and Sons, 6th Edition, 1995.
4. Streeter V. L, Wylie, E.B., "Fluid Mechanics", McGraw-Hill, 9th Edition, 1983.

VI. REFERENCE BOOKS:

1. Yuan S W, "Foundations of fluid Mechanics", Prentice-Hall, 2nd Edition, 1987.
2. Milne Thompson L M, "Theoretical Hydrodynamics", MacMillan, 5th Edition, 1968.
3. Rathakrishnan. E, "Fundamentals of Fluid Mechanics", Prentice-Hall, 5th Edition, 2007.
4. Som S. K, Biswas. G, "Introduction to fluid mechanics and fluid machines", Tata McGraw-Hill, 2nd Edition, 2004.

VII. WEB REFERENCES:

1. https://nptel.ac.in/courses/112105171/1
2. https://textofvideo.nptel.iitm.ac.in/112105171/lec1.pdf
3. https://www.fkm.utm.my/~syahruls/3-teaching/2-fluid-II/fluid-II-enote/32-pump-2.pdf
4. https://www.scribd.com/doc/16605891/Fluid-Mechanics